Dual-Space Decomposition of 2D Complex Shapes
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Motivation and Contribution
Shape decomposition is fundamental in human vision and shape recognition. For example, Minima rule states that human perceive shape as a collection of near convex parts.

Issues Complex shapes usually have many holes resulting from (1) overlapping objects; (2) inner structures or (3) sensor noise.

Existing methods focus on simple shapes either (1) provide no special care about holes or (2) decompose until no hole left.

Contribution
Base on the idea of nearly convex parts, we handle shapes that have either structurally important holes or holes due to topological noise.

Methodology
Dual-space Decomposition (DuDe): a divide-and-conquer approach
1. Decompose the complementary of input first;
2. Use the result from step 1 to assist the decomposition of original shape

Final Cut Selection
Solve a 0-1 integer linear programming
\[ \max S(R^T x) \]
subject to
\[ \sum_{x_i \in R} x_i \leq n, \]
and \[ x_i + x_j \in (0, 1), \forall (R_i, R_j) \in R \]
Where S is the score, R is the set of candidate cut, x is a 0-1 vector of size ||R||.

Human Segmentation & Evaluation
Human segmentation
1. Collected via Amazon Mechanical Turk
2. 142 people, 3818 segmentation
3. Each person takes 90+ seconds and produces 8.12 cuts per shape

We evaluate the quality of decomposition by
1. Rand Index (RI)
2. Cut Coverage (CC)

Measure Concavity
Concavity is measured as accumulated distance
\[ \text{concavity}(x) = \text{dist}(x, \beta_0) + \text{dist}(\beta_0, \beta_1) \]

Results
Our benchmark and source will be open to the public project webpage http://masc.cs.gmu.edu/wiki/Dude2D

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Reference